CONSERVATION PRACTICE STANDARD

WATER WELL
(No.)
CODE 642

DEFINITION

A hole drilled, dug, driven, bored, jetted or otherwise constructed to an aquifer.

PURPOSE

To provide water for livestock, wildlife, irrigation, human, and other uses.

To provide for general water needs of farming/ranching operations.

To facilitate proper use of vegetation on rangeland, pastures, and wildlife areas.

CONDITION WHERE PRACTICE APPLIES

On all land uses where the underground supply of water is sufficient in quantity and quality for the intended purpose.

This practice standard applies only to production wells. Specifically excluded are any types of wells installed solely for monitoring or observation purposes; injection wells; and piezometers. The standard does not apply to pumps installed in wells; above ground installations, such as pumping plants, pipelines, and tanks; temporary test wells; and decommissioning of wells (ASTM D 5299).

CRITERIA

Laws and regulations: Water wells must be planned, designed, and constructed to meet all federal, state, and local laws and regulations.

Suitability of Site: The availability of ground water for its intended use at the site shall be determined by using reliable local experience and reviewing all available relevant geologic maps and reports; well records maintained by state and federal agencies; and design, construction, and maintenance records of nearby wells. An appropriate level of investigation, including test well drilling, is conducted on-site, as needed, prior to well construction to determine site-specific hydrogeologic conditions.

The site shall be suitable for safe operation of the drilling equipment.

Well Head Protection: Wells shall be located at safe distances from potential sources of pollution. The allowable distance shall be based on consideration of site-specific hydrogeologic factors and shall comply with requirements of all applicable state or local regulations or construction codes.

Wells constructed through unconsolidated (soil) surface material shall be set back at least the following minimum distances from potential contaminant sources:

Contaminant Source	Distance (ft)
Waste Storage Facility	100
Waste Treatment Lagoon	100
Septic systems, Filter Areas	100
Fuel and Agri-Chemical Storage	100
Livestock and Poultry Housing	50
Barnyards, Feedlots, etc.	50
Sewers, Manure Transfer Lines	50
Silos	50

Isolation distances for wells constructed in shallow or surface rock formations shall be based on hydrogeologic investigations.

Surface runoff and drainage that might reach the wellhead from areas used by livestock or other contaminant sources shall be diverted.

Wells shall be located outside the 100 year floodplain of surface water bodies whenever possible, or be otherwise protected as required in “Grouting and Sealing”.

Wells shall be located a safe distance from both overhead and underground utility lines and other safety hazards.

Abandoned wells shall be decommissioned in accordance with the guidelines developed by the PA Geological Survey as provided in Act 610 of 1956. The decommissioning shall be completed prior to certification of the new well.

Borehole: Drilled, jetted, bored, and driven wells shall be sufficiently round, straight, and of adequate diameter, to permit satisfactory installation of inlet, well casing, filter pack, and annular seal, and passage of tremie pipe (including couplings), if used.

Use of Casing: Casing shall be installed to seal out undesirable surface or shallow ground water and to support the side of the hole through unstable earth materials. The intake portion of a well through stable geologic formations may not require casing.

Casing Diameter: Casing diameter shall be sized to permit satisfactory installation and efficient operation of the pump, and large enough to assure that uphole velocity is 5 feet per second or less, to protect against excessive head loss.

Materials: Casings may be of steel, iron, stainless steel, copper alloys, plastic, fiberglass, concrete, or other material of equivalent strength and durability consistent with the intended use of the water and the maximum anticipated differential head between the inside and outside of the casing.

Steel well casings shall meet or exceed requirements specified in ASTM A 589. Steel pipe manufactured for other purposes may be used if the quality of the pipe meets or exceeds requirements specified in ASTM A 589.

Only steel pipe casings shall be used in driven wells.

To prevent galvanic corrosion, dissimilar metals shall not be joined.

Plastic casings made of acrylonitrile-butadiene-styrene (ABS), polyvinyl chloride (PVC), or styrene-rubber (SR) shall conform to material, dimensional and quality requirements specified in ASTM F 480.

If the water is to be used for human consumption, plastic pipe shall be approved by the National Sanitation Foundation.

Plastic pipe manufactured for water or irrigation pipelines may be used if the quality equals or exceeds requirements specified in ASTM F 480.

Filament-wound fiberglass casings (glass-fiber-reinforced-thermosetting-resin pipe, RTRP) may be used if material meets requirements specified in ASTM D 2996. Tests for long-term cyclic pressure strength, long-term static pressure strength, and short-term rupture strength as required in ASTM D 2996 are not needed because the pipe is to be used for well casing. Joints shall meet requirements specified in section 3.8, ASTM F 480.

Fiberglass pressure pipe, (also called reinforced plastic mortar pipe, RPMP, or fiberglass pipe with aggregate) shall meet or exceed requirements specified in ASTM D 35l7.

Casing Strength: Well casing wall thickness shall be sufficient to withstand all anticipated static and dynamic pressures imposed on the casing during installation, well development, and use. Steel and plastic casing materials shall meet the strength requirements in the National Engineering Handbook, Part 631, Chapter 33 (NEH-631-33) “Investigations for Groundwater Resources Development.”

Joint Strength: Joints for well casings shall have adequate strength to carry the load due to the casing length and still be watertight, or shall be mechanically supported during installation to maintain joint integrity. Such mechanically supported casings shall terminate on firm material that can adequately support the casing weight.

Screen: Well screen shall be installed in any earth material likely to produce silt or sand. Well screens may be constructed of commercially manufactured screen sections, well points, or field-perforated sections.

Perforation by any method is allowable provided proper slot size and entrance velocity limits can be met. The length and open area of the screen shall be sized to limit entrance velocity of water into the well to less than or equal to 0.1 foot per second.

Depth of the aquifer below ground surface and the thickness of aquifer to be penetrated by the well shall govern the position of the screen in the well.

Maximum drawdown shall not be permitted below the top of the highest screen or pump intake.

Seals (Packers): Telescoped screen assemblies shall be provided with one or more sand-tight seals between the top of the telescoped screen assembly and casing.

Filter Pack: Installation of a filter pack around the well screen shall be considered under the following conditions: presence of a poorly graded, fine sand

aquifer; presence of a highly variable aquifer, such as alternating sand and clay layers; presence of a poorly cemented sandstone or similar aquifer; a requirement for maximum yield from a low-yielding aquifer; and holes drilled by reverse circulation.

Prepacked Well Screens: For heaving or caving sands, silty or fine-grained aquifers, and for horizontal or angled wells, a commercial prepacked well screen may be substituted for a conventionally installed (by tremie) filter pack.

Installation: Casing shall extend from above the ground surface down through unstable earth materials to an elevation of at least 2 feet into stable material or to the top of the screen.

All wells shall be cased to a sufficient height (minimum of 12 inches) above the ground surface to prevent entry of surface and near-surface water.

Casing for artesian aquifers shall be sealed into overlying, impermeable formations in such a manner as to retain confining pressure.

If a zone is penetrated that is determined or suspected to contain water of quality unsuitable for the intended use, the zone shall be sealed to prevent infiltration of the poor-quality water into the well and the developed portion of the aquifer.

Well Development: Wells to be completed without a filter pack in unconsolidated granular aquifers shall be developed following guidance provided in ASTM D 5521, Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers.

The method shall be selected based on geologic character of the aquifer, type of drilling rig, and type of screen.

Aquifer Development: For massive, unfractured rock formations unresponsive to well development procedures, the use of aquifer stimulation techniques may be considered to improve well efficiency and specific capacity. Techniques may include dry ice, acidizing, explosives, or hydrofracturing, depending on the composition and structure of the formation.

Grouting and Sealing: The annulus surrounding the permanent well casing at the upper terminus of the well shall be filled with expansive hydraulic cement (ASTM C 845), shrinkage-compensating concrete, bentonite-based grout, clay, or other material with similar sealing properties. The length of the grout seal shall be no less than 10 feet and not less than the minimum specified in state or locally applicable construction codes.

The top of the casing shall be equipped with a cap or well seal to prevent rainfall or insects from entering the well. If the top of the well casing is subject to flooding from surface water, the cap shall be water tight and equipped with a vent that extends two feet above the 100 year flood level. As an alternative, the well casing may be extended two feet above the 100 year flood level.

If the water is intended for human consumption, the casing shall be surrounded at the ground surface by a 4-inch thick concrete slab extending at least 2 feet in all directions.

A positive seal (grouted in place) or packer shall be provided between the casing and the less pervious material overlying the aquifer of artesian wells, and in all aquifers where co-mingling of waters is undesirable.

Access Port: An access port with a minimum diameter of 0.5 inch shall be installed to allow for unobstructed measurement of depth of the water surface, or for a pressure gage for measuring shut-in pressure of a flowing well. Access ports and pressure gages or other openings in the cover shall be sealed or capped to prevent entrance of surface water or foreign material into the well. Removable caps are acceptable as access ports.

Disinfection: Wells shall be disinfected immediately following their construction or repair to neutralize any contamination from equipment, material, or surface drainage introduced during construction. The disinfection process shall comply with all local or state requirements.

Water Quality Testing: Sampling and testing shall comply with all applicable federal, state, and local requirements. These requirements vary according to the water quality parameters associated with the intended use(s) of the water.

CONSIDERATIONS

The potential for adverse interference with existing nearby production wells needs to be evaluated in planning.

The potential for ground water overdraft and the long-term safe yield of the aquifer needs to be considered in planning.

Potential effects of installation and operation of the well on cultural, historical, archeological, or

scientific resources at or near the site need to be considered in planning.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared for specific field sites in accordance with this standard and shall describe the requirements for applying the practice to achieve its intended uses.

OPERATION AND MAINTENANCE

A plan for maintenance of a well shall be prepared. The well construction records shall be kept on file with the maintenance plan by the owner/operator. As a minimum, the plan shall include a statement of identified problems, corrective action taken, date, and specific capacity (yield per unit drawdown) of well before and after corrective action was taken.

WATER WELL
DESIGN AND CHECK DATA REQUIREMENTS

The following items must be addressed in the design folder for a water well. The following information shall be included:

(1) Table of Contents
(2) Operation and Maintenance Plan
(3) Construction Specifications
(4) Engineering Drawings
(5) Erosion and Sediment Control Plan
(6) Quality Assurance Plan

Listed below are specific items that are required in the design:

Table of Contents

This organizes the design folder.

Operation and Maintenance Plan

Provide the landowner with information on protecting the quality of the well water.

Construction Specifications

Enclose Specification 642 and other applicable specifications (e.g. 342, 362).

Include the projected water use (type of use, daily volume, and gpm) and any other "additional conditions" or items that are site specific or must be defined to supplement the standard specification. (See instructions for use of Specification 642.)

Add any special or "by-others" specifications.

Engineering Drawings

GENERAL
On each drawing sheet, the title block should show the farm operator's name, county and the persons involved in drawing and designing the water well.

A water well design prepared by NRCS or a cooperating agency requires approval by an Engineer with NRCS Engineering job approval authority for Water wells.

Include any standard drawings made by NRCS or designed by others and concurred in by NRCS that are needed, and include them in the drawing index on the cover sheet.

The design should **not** include the selected location for the well. Rather, it will show the areas that are available for the well. The well driller should have expertise in selecting the well location, based on the information provided in the design.

Listed are items that should be included:

PLAN VIEW SHEET
North arrow
Bench mark
Scale
Legend
Property lines
Utilities & PA One-Call information
Roads and farm lanes
Existing structures
Potential contaminant sources & setback requirements
Existing well, spring, & sinkhole location(s)
Water courses
100 year floodplain boundary or elevation

SEQUENCING STATEMENT WITH:
E&S control
Construction sequence
Special considerations
    Special equipment or site concerns
    Surface water diversion requirements
Vegetative requirements
Safety considerations

Act 187 (1996) statement

Erosion and Sediment Control Plan

See DEP's Erosion and Sediment Pollution Control Program requirements for water well drilling and aquifer testing.

Quality Assurance Plan

What specific items need inspection and when?
Include:

- setback requirements
- materials
- casing height above ground
- grouting
- wellhead protection
- water well completion report
- additional conditions

Who will do the actual inspection?

WATER WELL
INSTRUCTIONS FOR USE OF SPECIFICATION 642

1. APPLICABILITY

Construction Specification 642 is applicable to installation of water wells.

2. ITEMS TO BE INCLUDED IN SECTION 5 AND/OR DRAWINGS

a. Material requirements, including but not limited to:

   (1) Casing certification for anticipated head differential. Steel and plastic pipe must meet the strength requirements in National Engineering Handbook, Part 631, Chapter 33 (NEH-631-33) “Investigations for Groundwater Resources Development.” This reference should be given to the contractor.

b. Type of water use (e.g. human consumption, milking center, livestock water, etc.), daily volume, and gpm.

c. Statement that the contractor is responsible for the location and depth of the well, the method of installation, and any enhancements (e.g. gravel packs, well development, sealing of aquifers, etc.) based on what is encountered in installing the well.

d. State if aquifer development (hydrofracturing, etc.) is permitted

e. State if and in what locations surface water diversion will be required upslope of the well

f. If there is a potential for the well to be in the 100 year floodplain, state that flood protection is required for the wellhead.

g. Indicate any water quality testing requirements

h. State if other permits or approvals (e.g. Milk Sanitarian) are required

i. Safety items, including underground and overhead utilities

j. Erosion and sediment control

k. Vegetative requirements

l. Reference to other practice specifications (e.g. 342, 362), if applicable.

CONSTRUCTION SPECIFICATION

642. WATER WELL

1. SCOPE

The work shall consist of furnishing materials and installing all components of the water well as outlined in this specification and the drawings.

2. MATERIALS

Casings: Casings shall be of steel, iron, stainless steel, copper alloys, plastic, fiberglass, or concrete of sufficient strength and durability consistent with the intended use of the water and the maximum anticipated differential head between the inside and outside of the casing. Steel and plastic casing materials shall meet the strength requirements stated in Section 5 of this specification or in the drawings. Other casing materials shall be certified by the manufacturer or a registered Professional Engineer as being of adequate strength.

Steel well casings shall meet or exceed requirements specified in ASTM A 589. Steel pipe manufactured for other purposes may be used if the quality of the pipe meets or exceeds requirements specified in ASTM A 589.

Plastic casings made of acrylonitrile-butadiene-styrene (ABS), polyvinyl chloride (PVC), or styrene-rubber (SR) shall conform to material, dimensional and quality requirements specified in ASTM F 480.

If the water is to be used for human consumption, plastic pipe shall be approved by the National Sanitation Foundation.

Plastic pipe manufactured for water or irrigation pipelines may be used if the quality equals or exceeds requirements specified in ASTM F 480.

Filament-wound fiberglass casings (glass-fiber-reinforced-thermosetting-resin pipe, RTRP) may be used if material meets requirements specified in ASTM D 2996. Tests for long-term cyclic pressure strength, long-term static pressure strength, and short-term rupture strength as required in ASTM D 2996 are not needed because the pipe is to be used for well casing. Joints shall meet requirements specified in section 3.8, ASTM F 480.

Fiberglass pressure pipe, (also called reinforced plastic mortar pipe, RPMP, or fiberglass pipe with aggregate) shall meet or exceed requirements specified in ASTM D 35l7.

Concrete casing shall be reinforced and shall meet or exceed the requirements specified in ASTM C 76. The minimum 28-day compressive strength shall be 4,000 psi.

Joints: Well casing joints shall have adequate strength to carry the load due to the casing length and still be watertight, or shall be mechanically supported during installation to maintain joint integrity. Such mechanically supported casings shall terminate on firm material that can adequately support the casing weight.

Screen: Well screens shall be constructed of commercially manufactured screen sections, well points, or field-perforated sections. Perforation by any method is allowable provided proper slot size and entrance velocity limits can be met. The length and open area of the screen shall be sized to limit entrance velocity of water into the well to less than or equal to 0.1 foot per second.

Gravel Pack: If gravel pack is used, it shall have the gradation and thickness specified in the design.

Annular Seal: Expansive hydraulic cement (ASTM C 845), shrinkage-compensating concrete, or bentonite-based grout shall be used to seal the annulus between the casing and the outside of the drill hole. Other sealing material shall be approved by the Engineer before it is used.

3. EQUIPMENT

The installer shall provide and operate all equipment necessary to install the well in a safe

manner. The operator shall have a Water Well Driller's License and a Drilling Rig Permit, issued by the PA Geological Survey, for the equipment used on the site.

4. INSTALLATION

Drilled, jetted, bored, and driven wells shall be sufficiently round, straight, and of adequate diameter, to permit satisfactory installation of the inlet, well casing, filter pack, and annular seal, and passage of tremie pipe (including couplings), if used.

Casing: Casing shall extend from above the ground surface down through unstable earth materials to a depth of at least 2 feet into stable material or to the top of the screen.

All wells shall be cased to a sufficient height (minimum of 12 inches) above the ground surface to prevent entry of surface and near-surface water.

Only steel pipe casings shall be used in driven wells. To prevent galvanic corrosion, dissimilar metals shall not be joined.

Screen: Well screen shall be installed in any earth material likely to produce silt or sand.

Depth of the aquifer below ground surface and the thickness of aquifer to be penetrated by the well shall govern the position of the screen in the well.

Maximum drawdown shall not be permitted below the top of the highest screen or pump intake.

Seals (Packers): Telescoped screen assemblies shall be provided with one or more sand-tight seals between the top of the telescoped screen assembly and casing.

Gravel Pack: Where a gravel pack is used in unconsolidated aquifers, it shall be carefully placed to prevent segregation and bridging. Gravel pack material shall extend a minimum of 10 feet above the top of the perforated or screened section and shall extend through the depth of the water bearing formation.

For heaving or caving sands, silty or fine-grained aquifers, and for horizontal or angled wells, a commercial prepacked well screen may be substituted for a conventionally installed (by tremie) gravel pack.

Well Development: Wells to be completed without a filter pack in unconsolidated granular aquifers shall be developed following guidance provided in ASTM D 5521, Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers.

The method shall be selected based on geologic character of the aquifer, type of drilling rig, and type of screen.

Aquifer Development: For massive, unfractured rock formations unresponsive to well development procedures, the use of aquifer stimulation techniques may be used to improve well efficiency and capacity, if permitted in Section 5 of this specification. Techniques may include dry ice, acidizing, explosives, or hydrofracturing, depending on the composition and structure of the formation, and as specified in Section 5.

Grouting and Sealing: The annulus surrounding the permanent well casing at the upper terminus of the well shall be filled with approved annular sealing material. The depth of the annular seal shall be no less than 10 feet and not less than the minimum specified in applicable construction codes.

A positive seal (grouted in place) or packer shall be provided between the casing and the less pervious material overlying the aquifer of artesian wells in such a manner as to retain confining pressure.

If a zone is penetrated that is determined or suspected to contain water of quality unsuitable for the intended use, the zone shall be sealed to prevent infiltration of the poor-quality water into the well and the developed portion of the aquifer.

Well Cap: The top of the casing shall be equipped with a vented cap or well seal to prevent rainfall or insects from entering the well.

Access Port: An access port with a minimum diameter of 0.5 inch shall be installed to allow for unobstructed measurement of depth of the water surface, or for a pressure gage for measuring shut-in pressure of a flowing well. Access ports and pressure gages or other openings in the cover shall be sealed or capped to prevent entrance of surface water or foreign material into the well. Removable caps are acceptable as access ports.

Wellhead Protection: Surface runoff and drainage that might reach the wellhead from areas used by livestock or other contaminant sources shall be diverted away from the well.

The ground surface around the well shall be graded away from the well for a distance of at least five feet in all directions. Low points where water can puddle on the surface shall be eliminated.

If the well water is intended for human consumption, the casing shall be surrounded at the ground surface by a 4-inch thick concrete slab extending at least 2 feet in all directions.

If the top of the well casing is subject to flooding from surface water, either of two methods shall be used to prevent floodwater from entering the well: (1) the well cap shall be water tight and equipped with a vent that extends two feet above the 100 year flood level, or (2) the well casing shall be extended to two feet above the 100 year flood level.

Disinfection: Wells shall be disinfected immediately following their construction or repair to neutralize any contamination from equipment, material, or surface drainage introduced during construction. The disinfection process shall comply with all local or state requirements.

Water Quality Testing: Sampling and testing shall comply with all applicable federal, state, and local requirements. These requirements vary according to the water quality parameters associated with the intended use(s) of the water.

Documentation: The well driller shall provide to the landowner and the PA Geological Survey copies of the water well completion report.

5. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE: